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EXAMINER	
MCNELIS, KATHLEEN A	

ART UNIT	PAPER NUMBER
1742	

DATE MAILED: 10/03/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 10/03)

✓

Office Action Summary	Application No.	Applicant(s)
	10/668,668	DE FIGUEREDO ET AL.
	Examiner	Art Unit
	Kathleen A. McNelis	1742

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *24 July 2006*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-21 and 23-30* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-21 and 23-30* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

Claims Status

Claims 1-21 and 23-30 remain for examination wherein claims 1, 14, 15, 21, 23, 27 and 28 are amended and claims 29 and 30 are new.

Status of Previous Rejections

The previous rejections of claims:

- 1, 4, 14 and 28 under 35 U.S.C. 102(e) as anticipated or 35 U.S.C. 103(a) as obvious over Flemings et al.,
- 18-21 under 35 U.S.C. 103(a) as unpatentable over Flemings et al.,
- 2, 3, 5, 7, 8, 10-12, 15 and 16 under 35 U.S.C. 103(a) as unpatentable over Flemings et al. in view of Adachi et al.,
- 5, 6, and 22 under 35 U.S.C. 103(a) as unpatentable over Flemings et al. in view of Moschini,
- 9 under 35 U.S.C. 103(a) as unpatentable over Flemings et al. in view of Martinez et al.
- 23-27 under 35 U.S.C. 103(a) as unpatentable over EP '964 in view of Flemings et al.
- 13 under 35 U.S.C. 103(a) as unpatentable over Flemings et al. in view of Adachi and the ASM Metals Handbook
- 17 under 35 U.S.C. 103(a) as unpatentable over Flemings et al. in view of Moschini and DasGupta

are withdrawn in view of applicants' amendments to the claims.

Claim Rejections - 35 USC § 103

The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

<u>Claims 1, 4, 7, 8, 10, 14, 16, 18-21 and 28-30</u> are rejected under 35 U.S.C. 103(a) as being unpatentable over Flemings et al. (U.S. Pat. No. 6,645,323) in view of Winterbottom et al. (U.S. Pat. No. 6,742,567).

With respect to claims 1, 7 and 28-30, Flemings et al. discloses a process for preparing a metal alloy wherein the alloy is melted (rendered liquid) then rapidly cooled while vigorously agitating (abstract). In example 2 (col. 8 line 20 – col. 9 line 3), A356 alloy was heated to above the liquidus, then cooled to 608° C (i.e. a temperature between the solidus and liquidus) corresponding to about 18% solids fraction thereby forming nuclei (as in instant claims 1 and 30), cooling to solidify (as in instant claims 29), then reheating to a temperature of 590° C (i.e. a temperature between the solidus and liquidus) and holding isothermally (i.e. without raising the temperature of the alloy to thereby prevent the nuclei from melting) for approximately 20 minutes (i.e. at least 10 minutes) before quenching.

Flemings et al. does not disclose that the cooling rate of the nucleated alloy is at a rate of less than about 0.7 °C/sec when above the solidus thereby forming an alloy have an average particle size of about 100 μm or less as in instant claims 1, 7 and 28.

Winterbottom et al. discloses a method of producing a semi-solid material without stirring, including heating the metal to form a melt, crystallizing by cooling at a controlled rate to produce a semi-solid material (abstract) which reduces production costs (col. 3 lines 1-22). Winterbottom et al. teaches that controlling the cooling rate to between 0.01 5 °C/sec produces desirable microstructure without the requirement of stirring (col. 7 lines 20-65), resulting in rounded particles (i.e. substantially free of dendrites) ranging from about 40 to 150 μm (col. 8 lines 20-29). Producing substantially spherical primary solids is desired in Flemings et al. (col. 2 line 62 – col. 3 line 16). It would have been obvious to one of ordinary skill in the art at the time the invention was made to use the controlled cooling rate taught by Winterbottom et al. in the process of Flemings et al. to produce a desirable microstructure without the requirement of stirring, thus reducing production costs as taught by Winterbottom et al. The range of between 0.01 °C/sec to 5

°C/sec overlaps with the claimed range of less than about 0.7 °C/sec. It would have been obvious to one of ordinary skill in the art to use a cooling rate of between 0.01 and 0.7 °C/sec in Winterbottom et al., since Winterbottom et al. discloses equal utility over the entire range of between 0.01 °C/sec to 5 °C/sec, therefore a prima facie case of obviousness exists (M.P.E.P § 2144.05). Similarly, the size range of from about 40 to 150 μm overlaps the size range of about 100 μm or less.

With respect to claim 4, Flemings discloses that the process is suitable for alloys with lead, magnesium, zinc, aluminum, copper, iron, carbon (cast iron and steels), silicon, and tin (col. 6 lines 34-45).

With respect to claim 8, the range of between 40 to 150 μm overlaps the size range of about 70 μm or less, therefore a prima facie case of obviousness exists (M.P.E.P § 2144.05).

With respect to claim 10, Flemings et al. discloses quenching the alloy (Fig. 3(b)).

With respect to claim 14, Flemings et al. discloses an example wherein a melt is slowly cooled to a temperature of 7 °C above its liquidus prior to beginning the mixing and cooling (example 1a, col. 6 lines 50-67). 7 °C is within the claimed range of at least about 5 °C above the liquidus temperature.

With respect to claim 16, Winterbottom et al. discloses forming a billet (col. 4 lines 45-60).

With respect to claims 18-20, Flemings et al. discloses that the composition is cooled to an upper limit of about 40 to 65% solids, preferably 10 to 50% prior to directing to a forming step such as casting (col. 5 lines 1-15) as in instant claim 18. The range of 10% to 50% overlaps the claimed ranges of at least 30% (instant claim 19) and between about 40 to about 60% (instant claim 20). It would have been obvious to one of ordinary skill in the art at the time the invention

was made to direct the semi-solid alloy to forming with a solids volume fraction of between 40 and 50%, since Flemings et al. discloses that the preferred range is between 10 and 50%.

With respect to claim 21, Flemings et al. discloses a process for superheating an alloy, cooling and mixing the alloy to form a nucleated alloy with a plurality of nuclei distributed throughout, and the nuclei are substantially free of entrapped liquid, controlling the temperature to prevent melting of the nuclei and thereby forming an alloy essentially free of dendrites as described above regarding claim 1. In addition, Flemings et al. discloses a method for making the process continuous in a sub-vessel (reactor) while continuously cooling. Crystal nuclei form in a second sub-vessel (reactor) whereupon the liquid-solid composition is withdrawn as in claim 21, and can be shaped directly or solidified and reheated to form (col. 8 line 55 – col. 9 line 3). Further, making a process a continuous is prima facie obvious in the light of a batch process taught by prior art (see M.P.E.P. 2144.04 V E).

Claims 2, 3, 5, 11, 12 and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Flemings et al. (U.S. Pat. No. 6,645,323) in view of Winterbottom et al. (U.S. Pat. No. 6,742,567) as applied to claim 1 and further in view of Adachi et al. (U.S. Pat. No. 5,701,942).

Flemings et al. in view of Winterbottom et al. is applied as described above regarding claim 1.

With respect to claims 2 and 3, Flemings et al. in view of Winterbottom et al does not disclose that the alloy is cooled at a rate of at least 15 °C/sec as in instant claim 2 or that the cooling rate is in the range of about 20 to 30 °C/sec as in instant claim 3.

Adachi et al. discloses a method for casting an aluminum or magnesium alloy by superheating the alloy to not more than 30 °C. The liquid is then rapidly cooled at a rate of at least 1.0 °C/sec to form a billet (abstract). As the cooling rate increases, the size of crystal grains

decrease up to an experimental cooling rate of as high as 500 °C/sec, however Adachi et al. teaches that the cooling rate should not exceed 100 °C/sec as a practical limit (col. 4 lines 58-65). It would have been obvious to one of ordinary skill in the art at the time the invention was made to cool the alloy from superheat at a rate of at least 15 °C/sec or in a range of about 20 to 30 °C/sec as taught by Adachi et al. in the process of Flemings et al. in view of Winterbottom et al to produce small size grains within practical limits of cooling rate as taught by Adachi et al.

With respect to claim 5, Flemings et al. in view of Winterbottom et al does not disclose a process step for forming in a specific thixocasting or rheocasting application as in instant claim 5.

Adachi et al. discloses both a rheocasting and a thixocasting application (Figure 1) in that the melt is first superheated then cooled to room temperature (rheocast) before reheating in the region between solidus and liquidus and casting (thixocast). With respect to claim 16, Adachi et al. discloses forming a billet from the alloy (abstract). The process produces a billet of fine equiaxed crystals using a simple procedure (col. 2 lines 20-30).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to form a billet in the thixocasting process of Adachi et al. with the alloy of Flemings et al. in view of Winterbottom et al, since Flemings et al. teaches that the alloy can be processed by solidification of the alloy and Adachi et al. teaches that this is a simple process for producing a billet of fine equiaxed crystals.

With respect to claims 11 and 12, Flemings et al. in view of Winterbottom et al does not teach the use of aluminum or titanium borides as grain refiners.

Adachi et al. discloses an alloy with crystal grain size 50 μm resulting from using a Ti-B grain refiner and water quenching (col. 11 lines 35-40 and Fig. 15). The value of 50 μm falls within the ranges of about 100 μm or less (instant claim 7), about 70 μm or less (instant claim 8)

and was achieved using a grain-refining agent (instant claim 11) wherein the grain refining agent was a boride of titanium (instant claim 12) and quenched in a cold water tank (instant claim 10). It would have been obvious to one of ordinary skill in the art at the time the invention was made to use grain refiners and quenching as taught by Adachi et al. with the alloy of Flemings et al. in view of Winterbottom et al to produce a fine grained casting with a crystal grain size of 50 μm as taught by Adachi et al.

With respect to claim 15, Flemings et al. in view of Winterbottom et al does not teach that the alloy is superheated to a temperature in the range between about 10 and 15 °C

Adachi et al. discloses that the superheated alloy is heated to a temperature not more than 30 °C above the liquidus to obtain fine equiaxed crystals (col. 6 lines 24-35). The range of not more than 30 °C superheat overlaps with the claimed range of about 10 to about 15 °C. It would have been obvious to one of ordinary skill in the art at the time the invention was made to superheat the melt by about 10 to 15 °C above the liquidus, in the process of Flemings et al. in view Adachi et al. to obtain fine equiaxed crystals as taught by Adachi et al., since Adachi et al. teaches that any superheat not more than 30 °C is suitable for producing fine equiaxed crystals.

Claims 5 and 6 are rejected under 35 U.S.C. 103(a) as being unpatentable over Flemings et al. (U.S. Pat. No. 6,645,323) in view of Winterbottom et al. (U.S. Pat. No. 6,742,567) as applied to claim 1 above and further in view of Moschini (U.S. Pat. No. 5,464,053).

Flemings et al. in view of Winterbottom et al. is applied as described above regarding claim 1.

With respect to claims 5 and 6 Flemings et al. discloses that the alloy can be further processed by forming from the liquid melt or by solidification then reheat to form as discussed above regarding claim 1.

Flemings et al. in view of Winterbottom et al. does not disclose a process step for forming in a specific thixocasting or rheocasting application as in instant claim 5, or that the process includes passive mixing as in instant claim 6.

Moschini discloses a process for forming rheocast ingots by smelting a metal alloy and feeding the alloy under laminar flow conditions through a static mixer so as to obtain a semiliquid rheocast material at the outlet of the mixer (col. 5 lines 55-67). Feeding under laminar flow conditions prevents gaseous substances from being incorporated into the molten alloy (col. 5 lines 25-40). It would have been obvious to one of ordinary skill in the art at the time the invention was made to use the static mixing rheocast method of Moschini with the alloy of Flemings et al. in view of Winterbottom et al., since Flemings et al. discloses that the alloy can be further processed by forming the liquid melt and the static mixing method of Moschini prevents gas inclusions in the molten alloy.

<u>Claim 9</u> is rejected under 35 U.S.C. 103(a) as being unpatentable over Flemings et al. (U.S. Pat. No. 6,645,323) in view of Winterbottom et al. (U.S. Pat. No. 6,742,567) as applied to claim 1 and further in view of Martinez et al. ("Efficient Formation of Structures Suitable for Semi-Solid Forming", Transactions 21st International Die Casting Congress & Exposition, October 29-Nov. 1, 2001).

Flemings et al. in view of Winterbottom et al. is applied as described above regarding claim 1.

Flemings et al. in view of Winterbottom et al. does not disclose that the shape factor is in the range of about 0.75 to 0.95.

Martinez et al. discloses the results of testing the effect of varying stirring time and speed (rpm) upon shape factors (abstract, p. 47), wherein each of the stirring time and speed were varied

(pp. 48-49). The results indicate that shape factors of between 0.75 and 0.95 are achieved (figures 8 and 9) and that increasing stirring speed results in greater sphericity (fig. 9 and p. 49, conclusions). Stirring speed is therefore recognized as result-effective variable in the art, which is varied to affect the sphericity and therefore the calculated shape factor of the grains of alloys produced in semi-solid forming methods. It would have been obvious to one of ordinary skill in the art at the time the invention was made to adjust the stirring speed as taught by Martinez et al. in the process of Flemings et al. in view of Winterbottom et al. to achieve a shape factor in the range of 0.75 to 0.95 as disclosed by Martinez et al. (see M.P.E.P 2144.05, II, B).

<u>Claim 13</u> is rejected under 35 U.S.C. 103(a) as being unpatentable over Flemings et al. (U.S. Pat. No. 6,645,323) in view of Winterbottom et al. (U.S. Pat. No. 6,742,567) and Adachi et al. (U.S. Pat. No. 5,701,942) as applied to claim 11, and further in view of the ASM Metals Handbook, 9th edition, Vol. 15, Casting.

Flemings et al. in view of Winterbottom et al. and Adachi et al. are applied as discussed above regarding claim 11.

The ASM Metals Handbook, Vol. 15, casting teaches that boron is added to aluminum alloys to react with other metals such as aluminum and titanium to form borides such as TiB_2 to form stable nucleation sites for interaction with active grain-refining phases in molten aluminum (p. 744). It would have been obvious to one of ordinary skill in the art at the time the invention was made that the Ti and B added to the alloy of Flemings et al. in view of Winterbottom et al. and Adachi et al. for grain refinement would form borides including TiB_2 as taught by the ASM Metals Handbook.

<u>Claim 17</u> is rejected under 35 U.S.C. 103(a) as being unpatentable over Flemings et al. (U.S. Pat. No. 6,645,323) in view of Winterbottom et al. (U.S. Pat. No. 6,742,567) as applied to

claim 1 and further in view of Moschini (U.S. Pat. No. 5,464,053) and DasGupta (U.S. Pat. No. 6,908,590).

Flemings et al. in view of Winterbottom et al. is applied as described above regarding claim 1.

Flemings et al. in view of Winterbottom et al. and Moschini discloses a process for rheocasting ingots by smelting a metal alloy and feeding that alloy under laminar flow conditions through a static mixer to obtain a rheocast material as described above regarding claims 5 and 6.

Flemings et al. in view of Winterbottom et al. and Moschini does not disclose recycling the metal alloy from the forming process as in instant claim 17.

DasGupta teaches that an economic advantage of rheocasting over thixocasting is that the scrap metal from forming can be recycled in the rheocasting process (col. 2 lines 4-15). It would have been obvious to one of ordinary skill in the art at the time the invention was made to recycle scrap as taught by DasGupta from the forming process of Flemings et al. in view of Moschini to the smelting process of Flemings et al. in view of Winterbottom et al. and Moschini to benefit from the cost savings as taught by DasGupta.

Claims 23-27 are rejected under 35 U.S.C. 103(a) as being unpatentable over EP 0 745 694 (EP '694) in view of Winterbottom et al. (U.S. Pat. No. 6,742,567).

EP '694 discloses a method and apparatus for semisolid forming of alloys with fine-grained spherical structures in a convenient, easy and inexpensive manner (abstract). EP '694 provides and example (example 13 and Fig. 70) wherein two or more liquid alloys having different melting points are heated above the liquidus, then mixed either directly or within an insulated vessel having a heat insulating effect to generate crystal nuclei in the alloy solution. The alloy resulting from mixing MA and MB is designated MC, and mixing is such that the resulting

temperature is above the liquidus of MC (i.e. superheated). Crystal nuclei generated grow into non-dendritic primary crystals (pp. 48-51). EP '694 teaches that the alloy is held between the liquidus and solidus temperatures for a period between 5 seconds and 60 minutes (p. 8 lines 30-35), which overlaps the claimed range of at least 10 minutes, therefore a prima facie case of obviousness exists.

EP '694 does not disclose that the cooling rate of the nucleated alloy is at a rate of less than about 0.7 °C/sec when above the solidus thereby forming an alloy have an average particle size of about 100 μm or less as in instant claims 1, 7 and 28.

Winterbottom et al. discloses a method of producing a semi-solid material without stirring, including heating the metal to form a melt, crystallizing by cooling at a controlled rate to produce a semi-solid material (abstract) which reduces production costs (col. 3 lines 1-22). Winterbottom et al. teaches that controlling the cooling rate to between 0.01 5 °C/sec produces desirable microstructure without the requirement of stirring (col. 7 lines 20-65), resulting in rounded particles (i.e. substantially free of dendrites) ranging from about 40 to 150 μm (col. 8 lines 20-29). It would have been obvious to one of ordinary skill in the art at the time the invention was made to use the controlled cooling rate taught by Winterbottom et al. in the process of EP '694 to produce a desirable microstructure without the requirement of stirring, thus reducing production costs as taught by Winterbottom et al. The range of between 0.01 °C/sec to 5 °C/sec overlaps with the claimed range of less than about 0.7 °C/sec. It would have been obvious to one of ordinary skill in the art to use a cooling rate of between 0.01 and 0.7 °C/sec in Winterbottom et al., since Winterbottom et al. discloses equal utility over the entire range of between 0.01 °C/sec to 5 °C/sec, therefore a prima facie case of obviousness exists (M.P.E.P § 2144.05). Similarly, the size range of from about 40 to 150 μm overlaps the size range of about 100 μm or less.

With respect to claim 24, lacking any limitation on "dissimilar composition", the alloys mixed in EP '694 are dissimilar in that they are not the same alloy and have different melting temperatures (footnote 3 of Table 9, page 50).

With respect to claim 25, the two metal alloys in example 13 of EP '694 are heated to nonequal temperatures as shown on Table 9 wherein two alloys have different melting points but are heated to the same degree of superheat (footnotes 2 and 3, Table 9, page 50).

With respect to claims 26 and 27, the melting points of two metal alloys in example 13 of EP '694 are 20 degrees apart (footnote 3, p. 50). Assuming the "first metal" is the higher melting point metal, the superheat is given in Table 9 as ranging from 0 to 15 °C superheat, which would be within the range of between about 1°C and 50 °C superheat above the liquidus temperature of the lower melting point second metal as in instant claim 26. The superheat of the second metal is given as between 1 and 20 °C superheat (p. 50 Table 9) which is within the claimed range of between 1 and 50°C superheat in instant claim 27.

Additional Citations

Zoqui et al. (2002) discloses that the liquidus temperature of A356 is 614 °C and the solidus is 554 °C (p. 39).

Response to Arguments

Applicant's arguments with respect to claims 1-21 and 23-28 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL.** See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Kathleen A. McNelis whose telephone number is 571 272 3554. The examiner can normally be reached on M-F 8:00 AM to 4:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Roy King can be reached on 571-272-1244. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

KAM
9/28/06

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